



# The James Webb Space Telescope: Observatory Status and the Path to Launch

Michael McElwain  
JWST Observatory Project Scientist

Chuck Bowers, Mark Clampin, Mal Niedner

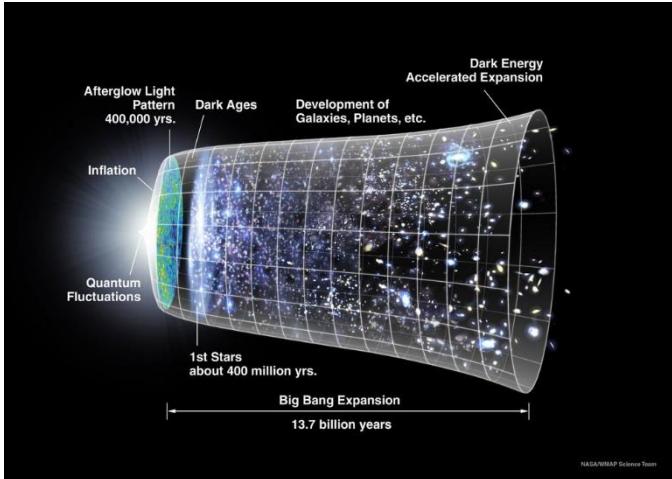
June 26, 2016



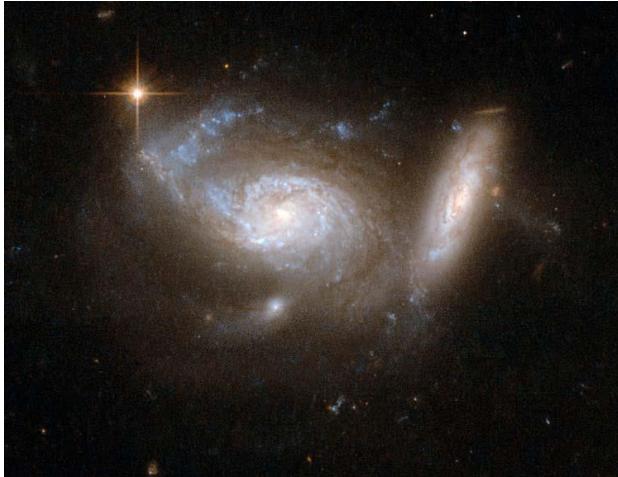


# JWST Science Themes

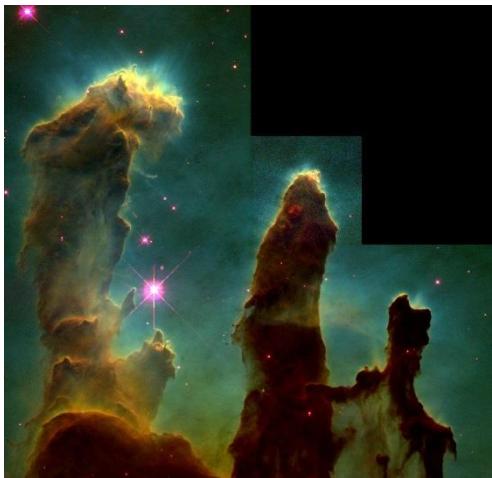
## First Light & Reionization



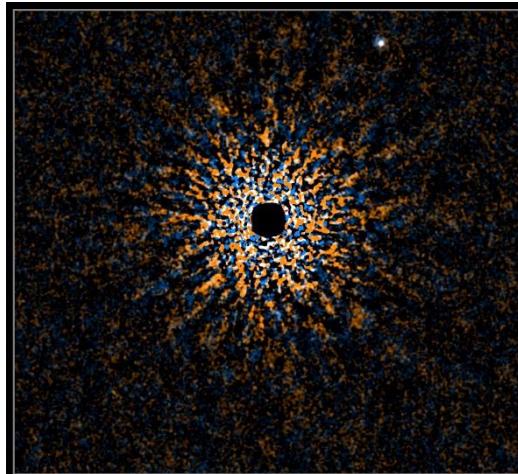
## Assembly of Galaxies



## Birth of Stars and Protoplanetary Systems



## Planets and the Origins of Life





# JWST Team



## Organizations

- Mission Lead: Goddard Space Flight Center
- Project Scientist: Dr. John Mather (Nobel Laureate)
- International Partners: ESA & CSA
- Observatory Contractor: Northrop Grumman Aerospace Systems
- Operations Center: Space Telescope Science Institute



## Instruments

- NIRCam (Near Infrared Camera) – Univ. of Arizona
- NIRSpec (Near Infrared Spectrograph) – ESA
- MIRI (Mid-Infrared Instrument) – ESA/JPL
- Fine Guidance Sensor/NIRISS – (FGS/NIRISS) – CSA





# How JWST Works

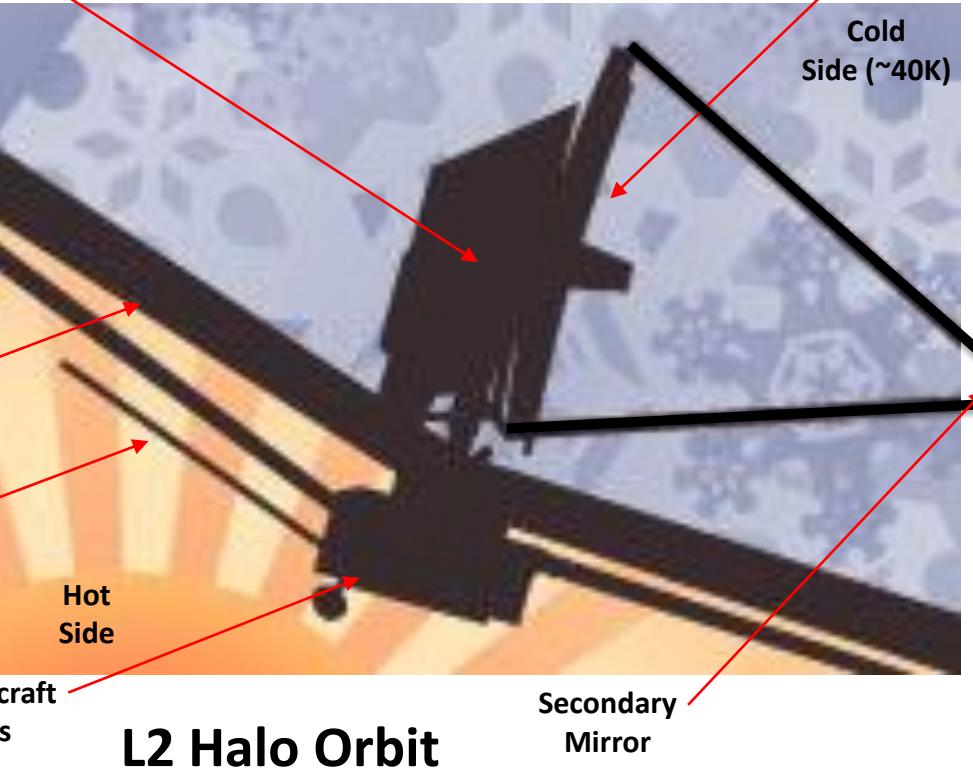
## Ariane V Launch Vehicle



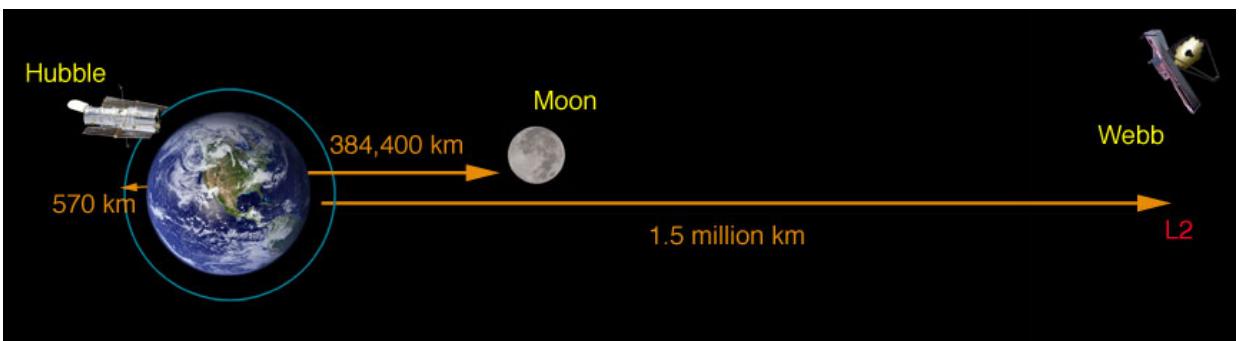
JWST is folded and stowed for launch

Integrated Science  
Instrument Module

JWST Deployed

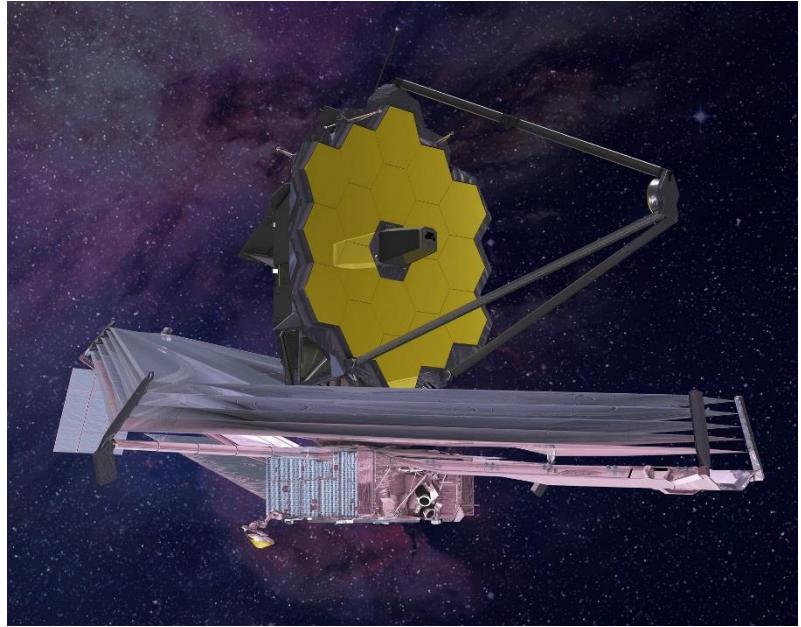


L2 Halo Orbit

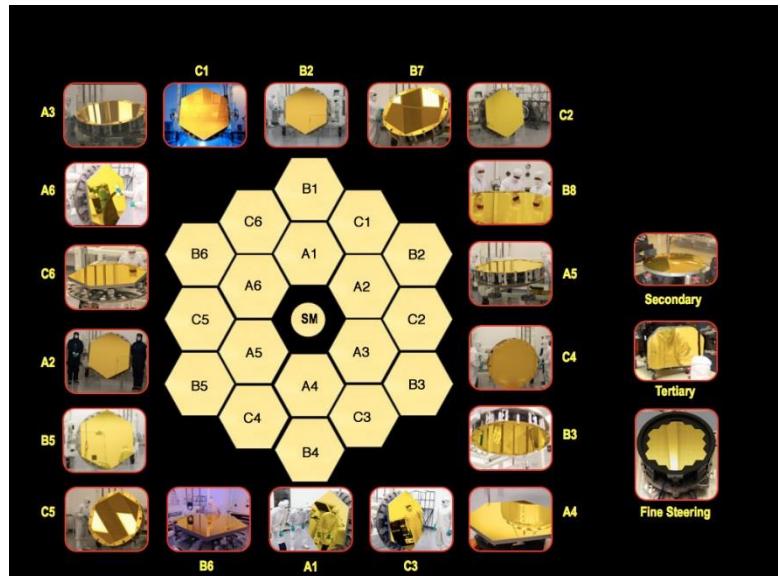
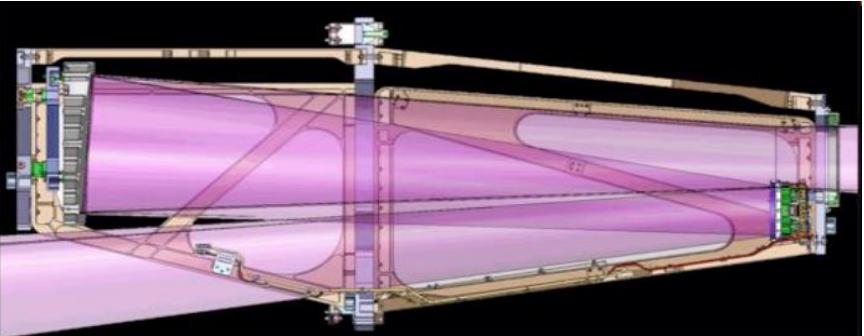




# Optical Telescope Element (OTE)



# Aft-Optics System



SI Field Location	Requirement (RMS WFE, nm)	Measured (RMS WFE nm)
NIRCam	131	114
NIRSpec	131	119
MIRI	131	117
NIRISS	150	119

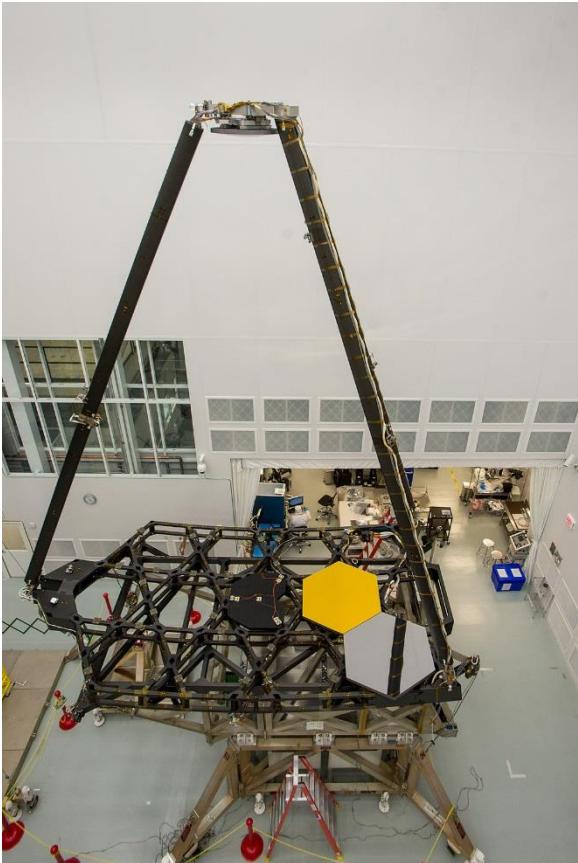
## See Atkinson 9904-2<sup>5</sup>



# Telescope Structure



## Pathfinder



## Flight Telescope Structure

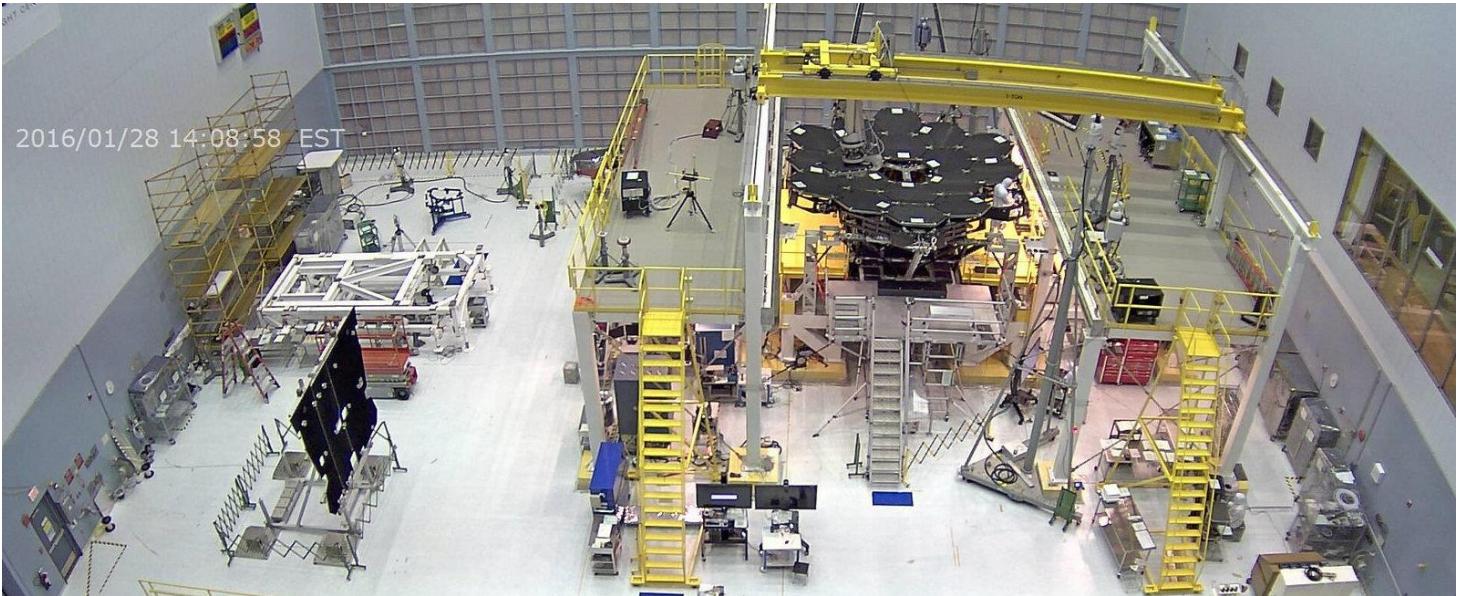


Center Section  
(CS)

Wings



# JWST OTE Integration



Primary Mirror Installation



Secondary Mirror Installation



AOS Installation



See Matthews 9904-3



# Optical Telescope Element (OTE)



**JWST OTE +V1**



**JWST OTE +V3, SM Stowed**





# OTE + ISIM = OTIS



## JWST OTE –V1, ISIM Installation



## ISIM Installation from AOAS



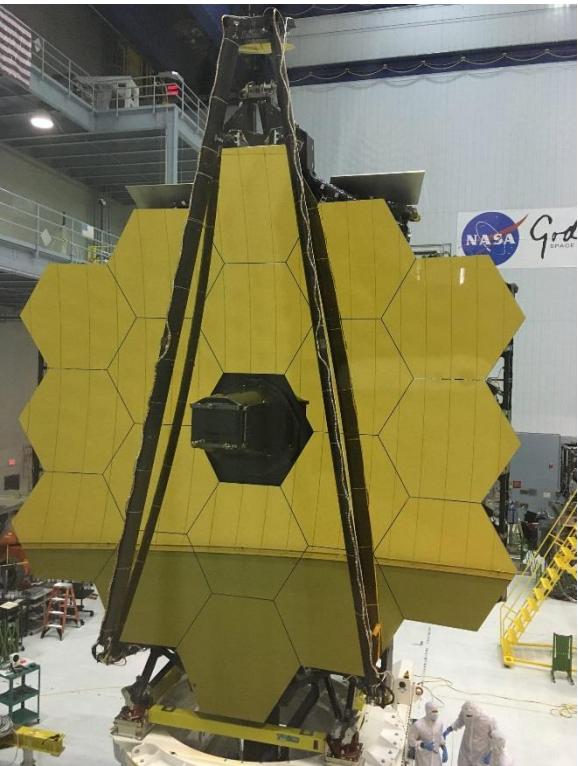


# OTIS Integration and Test Program



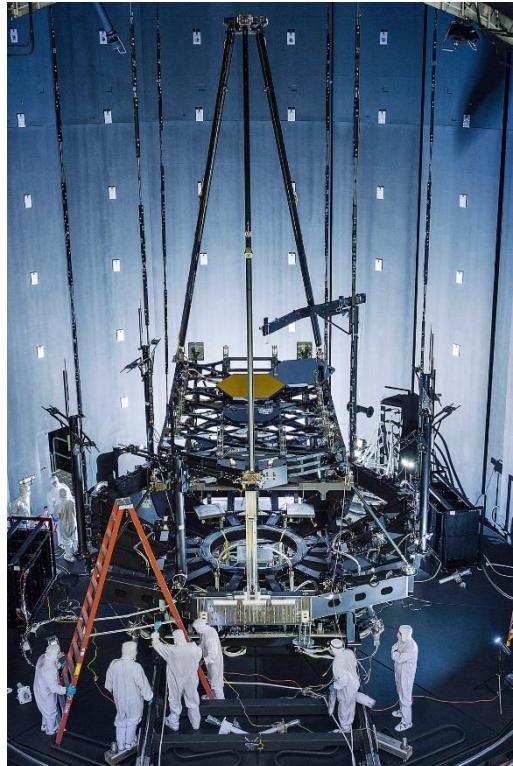
## Ambient Testing at NASA Goddard

- Test data taken before and after acoustic/vibrational testing
  - Primary mirror metrology
  - Primary mirror structure dynamics, deployments, and electrical testing



## Cryogenic at NASA Johnson

- Optical Workmanship
- Optical Alignment
- Thermal balance
- Operational Interfaces



See Feinberg 9904-6<sup>10</sup>



# Johnson Space Center Chamber A



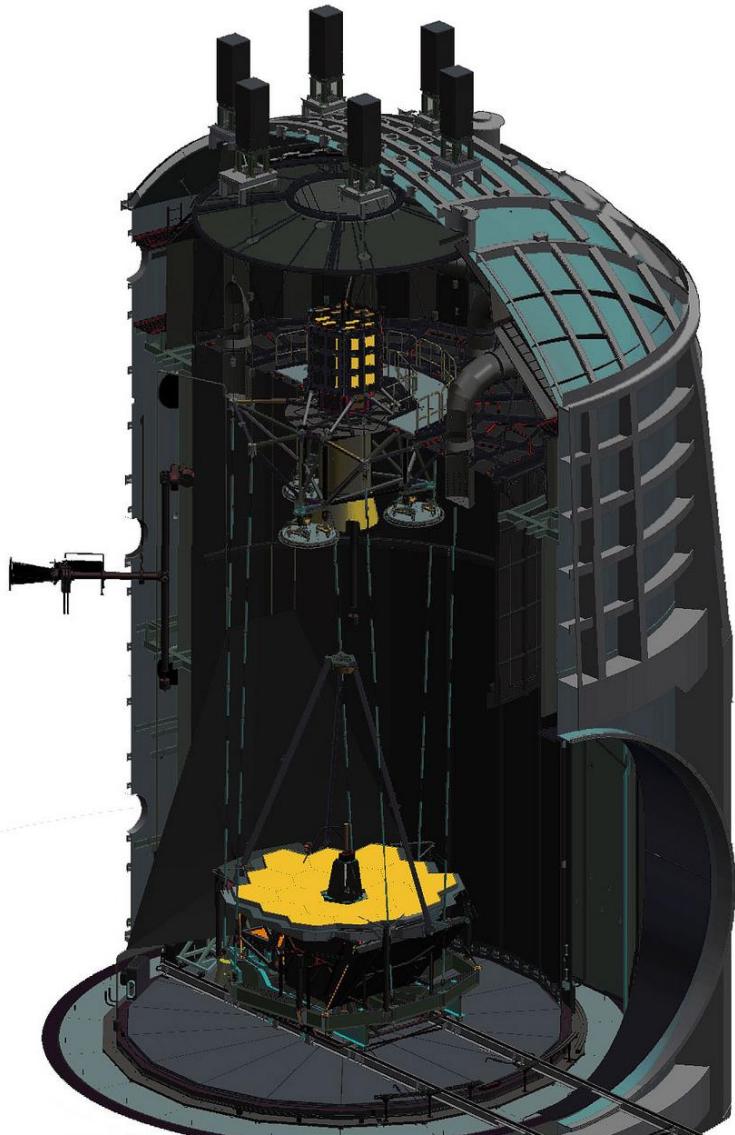
JWST Space Telescope Transporter for Air, Road and Sea (STTARS)



Apollo command module test in JSC's Chamber A (1968)



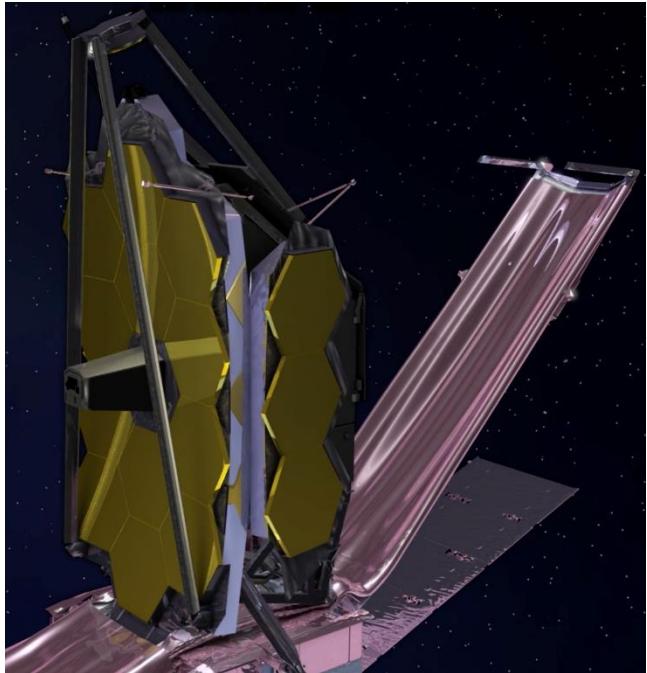
JWST configuration for OTIS cryo-test inside JSC's Chamber A (2017)



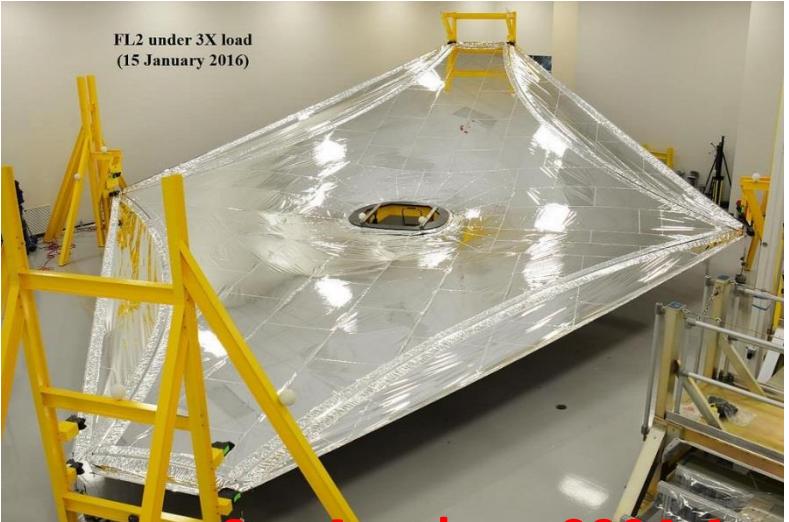


# Sunshield

- Five separate sunshield layers manufactured by NeXolve.
  - Layers tensioned to flight-like configuration
  - Shape measured in 3-dimensions using lidar
  - Modeling of layer to layer alignments
- Full-sized flight simulator tested



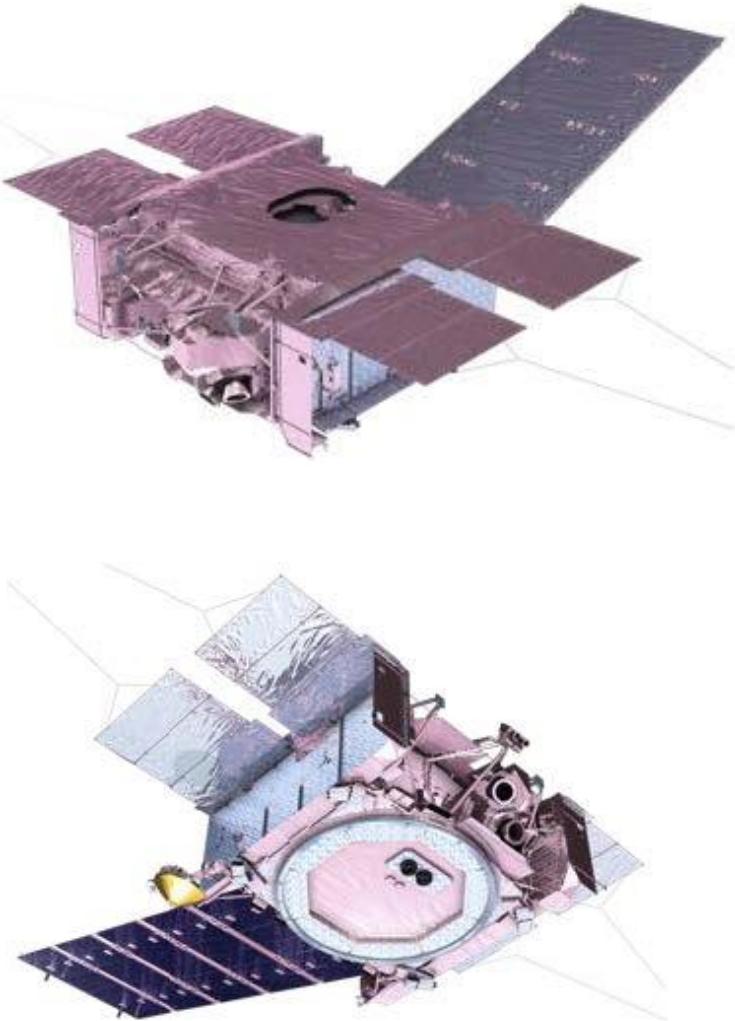
Flight Sunshield Layer 2



See Arenberg 9904-4



# Spacecraft Bus

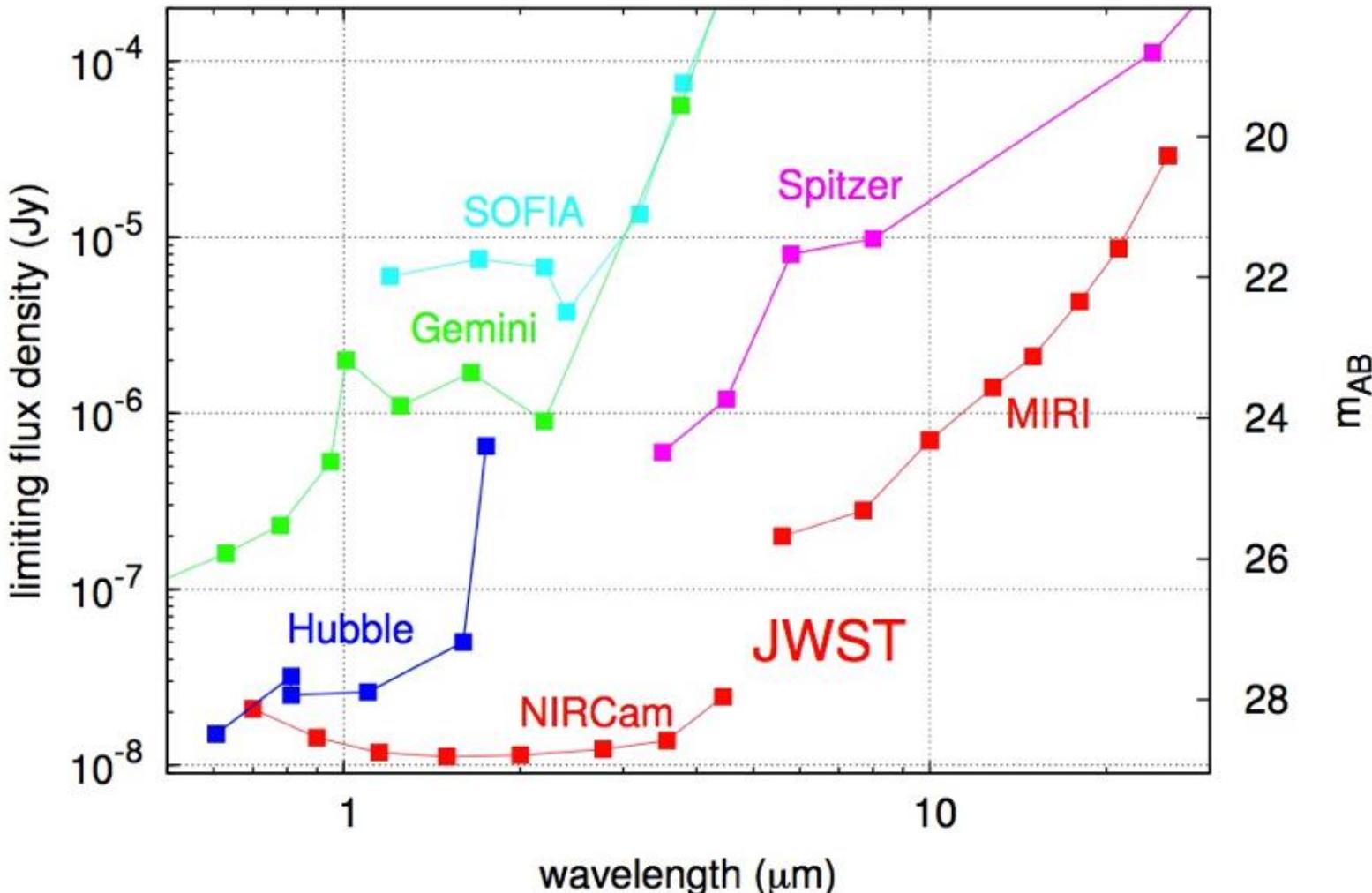




# Observatory Sensitivity: Imaging



photometric performance, point source, SNR=10 in  $10^4$ s

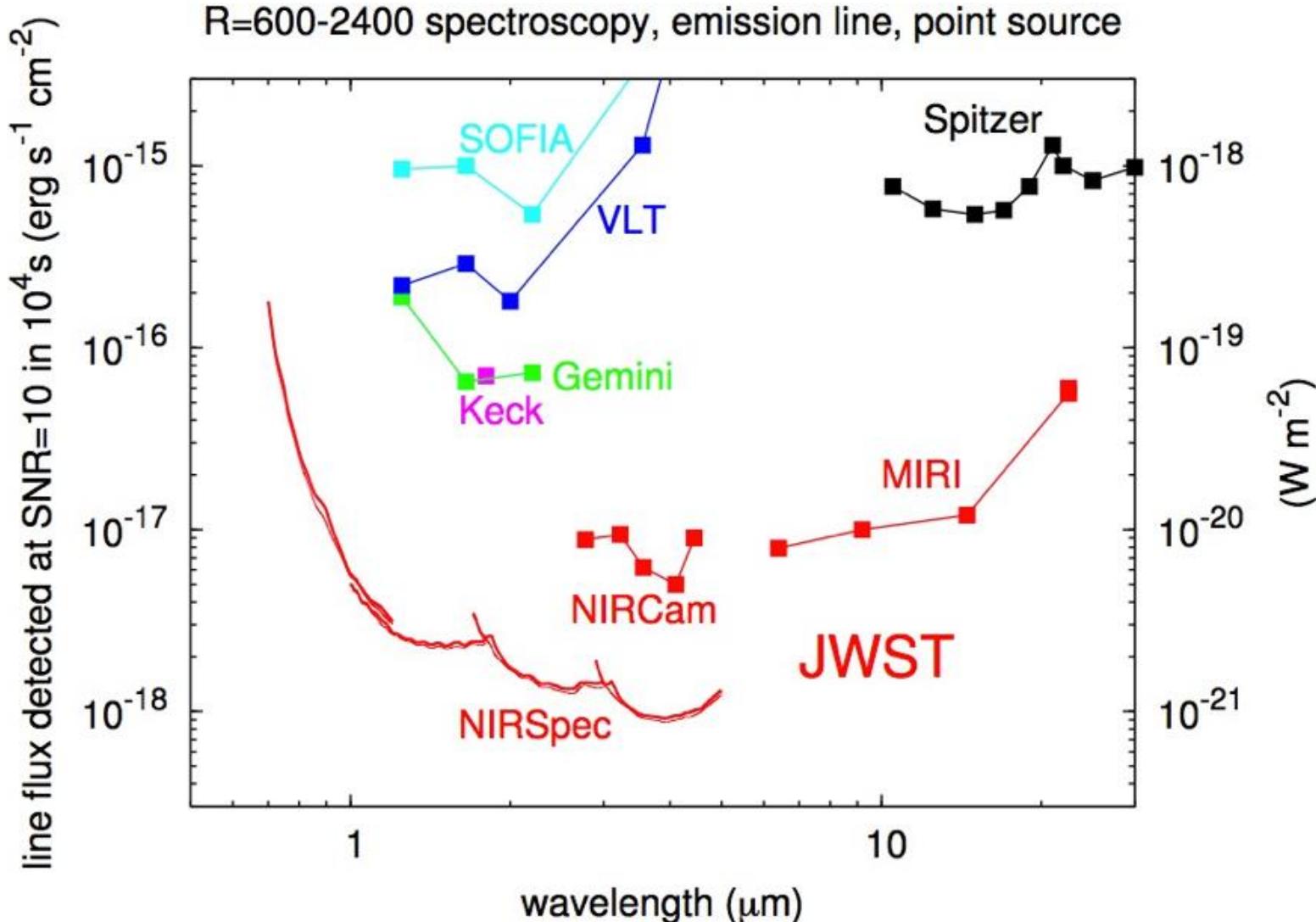


See <https://jwst.stsci.edu/science-planning/>

Courtesy of Jane Rigby



# Observatory Sensitivity: Spectroscopy



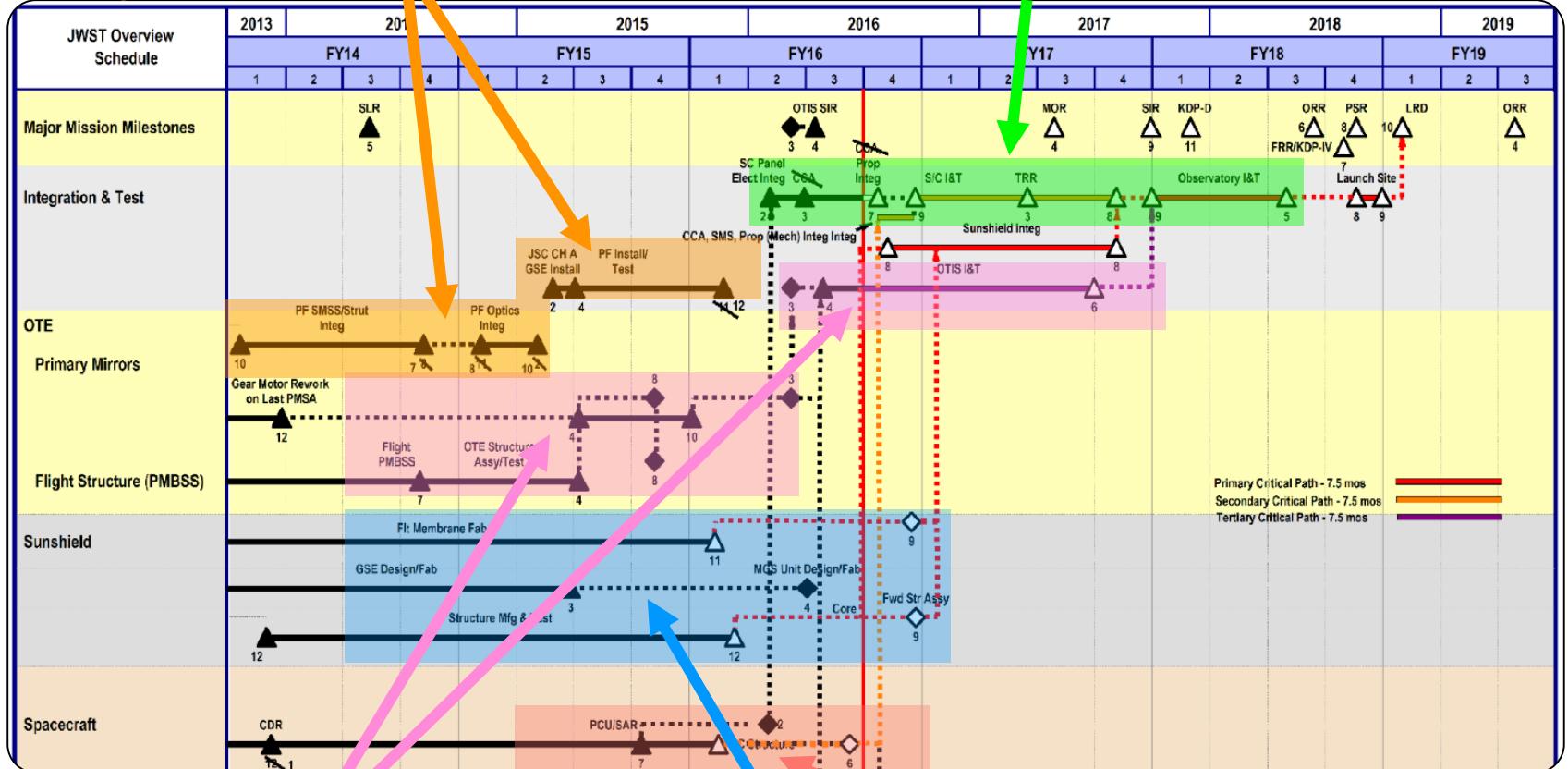
See <https://jwst.stsci.edu/science-planning/>  
Courtesy of Jane Rigby



# Observatory Schedule

Pathfinder backplane/SMSS  
- integration & test

Telescope/Sunshield/Spacecraft  
- integration & test



Primary Mirror Support Structure:  
- Assembly completion and cryo-test  
- Mirror population

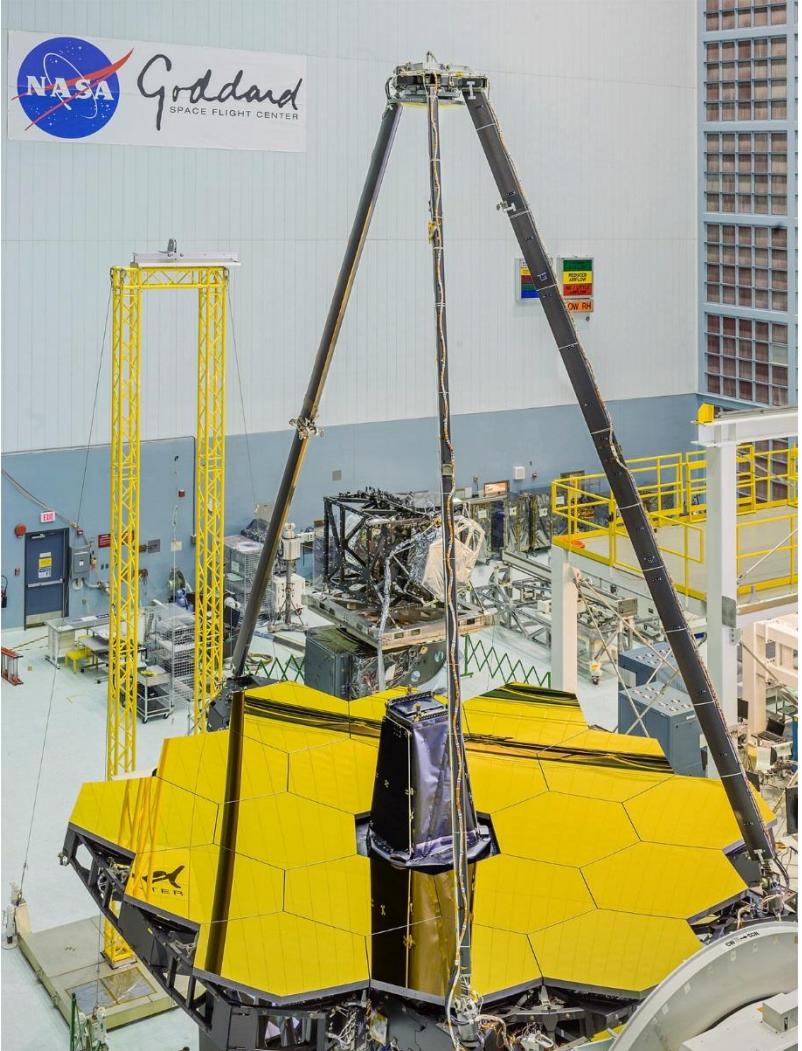
Sunshield Flight Membrane fabrication:  
- Sunshield structure integration and test

Spacecraft: Fabrication &  
subsystem integration



# Summary

- JWST will carry out transformative science from the very early universe and across cosmic time.
- JWST OTE and ISIM have been combined to form OTIS, which will commence environmental testing.
- The full JWST team has made tremendous progress since the last AT+I meeting in 2014.
- JWST on track following 2011 replan and remains on schedule to launch in October 2018.





# Following JWST

## Webpages

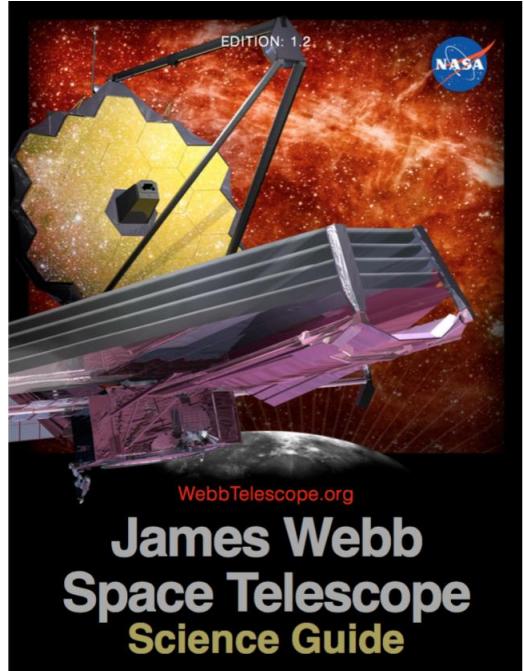
[www.jwst.nasa.gov](http://www.jwst.nasa.gov)



[webbtelescope.org/](http://webbtelescope.org/)



## Webb e-book



## Webcam

[www.jwst.nasa.gov/webcam.html](http://www.jwst.nasa.gov/webcam.html)

## Social Media

